MODEL 21980
CHASSIS D900D RUN I
BOOK NO. 94X925 352

television
SERVICE MANUAL

92X1729

1951
SERIES

MODEL 21980—MAHOGANY FINISH CONSOLE WITH 19 INCH ROUND METAL CONE PICTURE TUBE

the hallicrafters co.
MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 24, U. S. A.

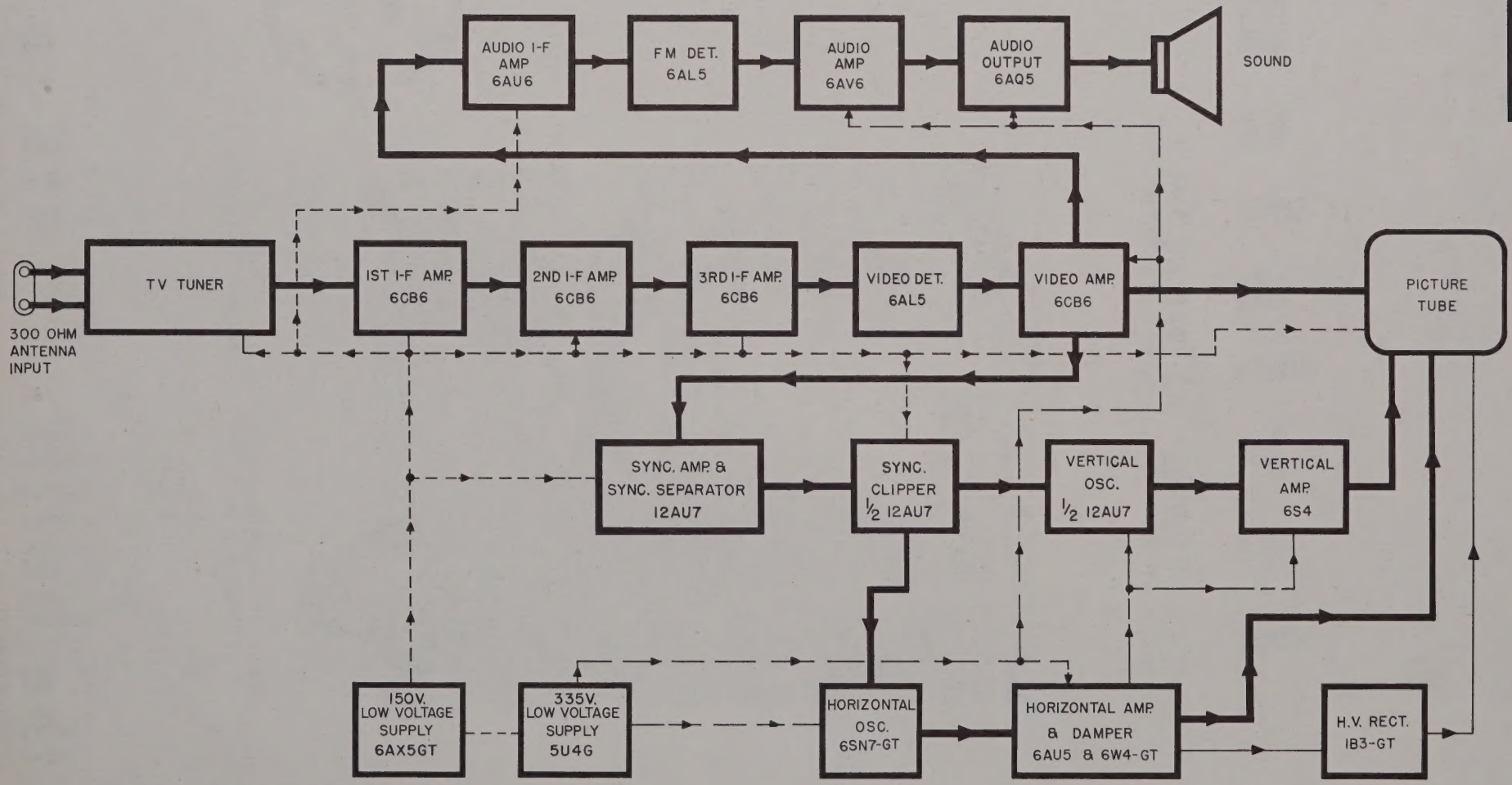


Fig. 1. Functional Block Diagram

GENERAL SPECIFICATIONS

ANTENNA	EXTERNAL OR BUILT-IN SILVER VORTEX
ANTENNA INPUT IMPEDANCE	300 OHMS
TUNING	12 CHANNELS, 2-13
POWER SUPPLY	110-120 V., 60 CYCLES
POWER INPUT	235 WATTS
PICTURE CARRIER IF	26.25 MC
SOUND CARRIER IF	21.75 MC
INTERCARRIER SOUND SYSTEM	4.5 MC
SPEAKER	10 INCH PM
TUBES	21, INCLUDING 3 RECTIFIERS

TUBE COMPLEMENT

V-1	6AG5, 6BC5, OR 6CB6	RF AMPLIFIER
V-2	6J6	OSC./MIXER
V-101	6CB6	1ST IF AMPLIFIER
V-102	6CB6	2ND IF AMPLIFIER
V-103	6CB6	3RD IF AMPLIFIER
V-104	6AL5	VIDEO DETECTOR
V-105	6CB6	VIDEO AMPLIFIER
V-106	12AU7 OR 6SN7GT*	SYNC. AMP. & SEP.
V-107	12AU7 OR 6SN7GT*	SYNC. CLIPPER & VERTICAL OSC.
V-108	6S4	VERTICAL AMPLIFIER
V-109	6AU6	AUDIO IF AMPLIFIER
V-110	6AL5	AUDIO DETECTOR
V-111	6AV6 OR 6SQ7*	1ST AUDIO AMPLIFIER
V-112	6AQ5	AUDIO OUTPUT
V-113	6AX5GT OR 6X5GT	LV RECTIFIER
V-114	5U4G	LV RECTIFIER
V-115	6SN7GT	HORIZONTAL OSCILLATOR
V-116	6AU5GT OR 6AV5GT	HORIZONTAL AMPLIFIER
V-117	6W4GT	DAMPER
V-118	1B3GT	HV RECTIFIER
V-119	19AP4A	19" METAL ROUND BLACK PIX TUBE

* These tubes are not directly interchangeable. For socket wiring of each type refer to the schematic diagram. When replacing tubes use the same types found in the receiver chassis.

REMOVAL OF THE CHASSIS FROM THE CABINET

1. Remove the knobs on the front panel by pulling in the forward direction.
2. Loosen the panel, mounted on the cabinet back, through which the CENTERING CONTROL LEVER PROTRUDES, by removing the CENTERING CONTROL LOCK SCREWS(S).
3. Remove the screw located directly above the SAFETY CONNECTOR.
4. Disconnect the built-in antenna leads from the antenna terminal strip.
5. Remove the cabinet back mounting screws and then remove the cabinet back.
6. Remove the speaker plug at the chassis.
7. Removal of the chassis may now be completed by removing the five chassis mounting screws (located at bottom of cabinet) and sliding the chassis from the cabinet.

WARNING

PICTURE TUBE HANDLING PRECAUTIONS

THE PICTURE TUBE ENVELOPE ENCLOSES A HIGH VACUUM. ANY ACCIDENTAL BLOW OR ROUGH HANDLING MAY CAUSE THE TUBE TO IMPLODE WITH DANGEROUS AND DESTRUCTIVE VIOLENCE. THE PICTURE TUBE SHOULD BE HANDLED ONLY BY QUALIFIED PERSONS PROTECTED BY HEAVY GLOVES AND SHATTERPROOF GOGGLES.

HIGH VOLTAGE WARNING

OPERATION OF THE RECEIVER CHASSIS OUTSIDE OF THE CABINET INVOLVES DANGER OF ELECTRICAL SHOCK. EXERCISE ALL NORMAL HIGH VOLTAGE PRECAUTIONS WHEN WORKING WITH THIS RECEIVER.

SERVICE ADJUSTMENTS

Note: The sequence of "SERVICE ADJUSTMENTS" outlined herein is suggested as a convenient method of approach. and is not an arbitrary procedure. Variations of the procedure are permitted to obtain the final result.

The following service adjustments will require only occasional minor adjustment as tubes age or are replaced. Any circuit changes or repairs will probably necessitate readjustment of the service adjustments. A test pattern, generated either in the shop or obtained from a television station, is recommended for best results. The operating and auxiliary controls, located on the front panel, should be set for as good a pattern as possible before making any of the following adjustments.

If it is not possible to obtain proper focus by means of the FOCUS control on the front of the chassis, set the control at the center of the range over which it may be rotated and adjust the FOCUS COIL INDUCTANCE RING to obtain good focus within the range of the FOCUS control. It is necessary to remove the cabinet back to adjust the FOCUS COIL INDUCTANCE RING.

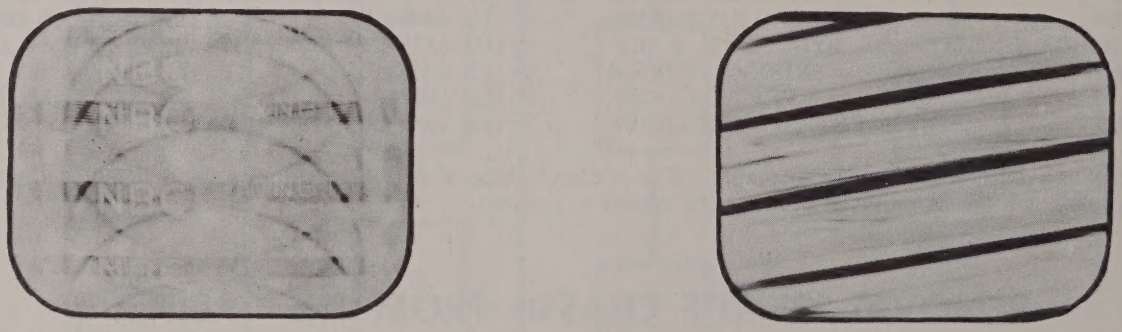


Fig. 2. Improper Adjustment of Vertical and Horizontal Hold Controls

Adjust the VERTICAL and HORIZONTAL hold controls for a single steady picture. When the hold controls are properly adjusted it should be possible to switch from one station to another with the picture remaining steady on any station.

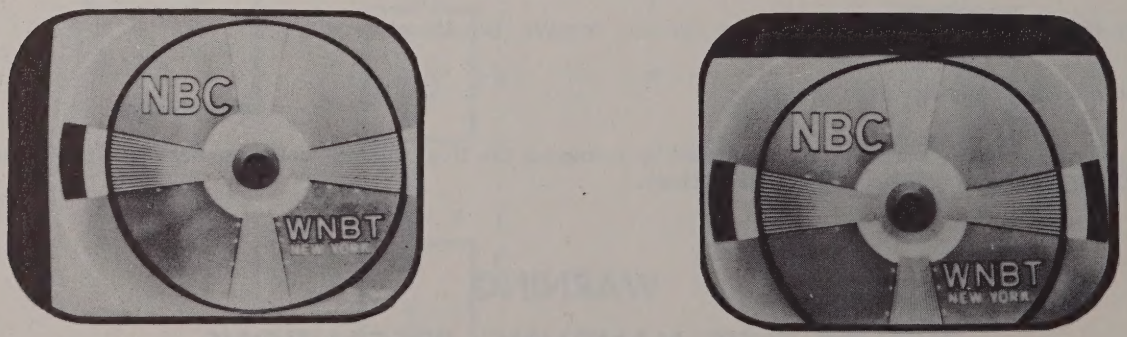


Fig. 3. Improper Centering Adjustments

If the picture is not properly centered, remove the CENTERING CONTROL LOCK SCREW(S) and move the CENTERING LEVER a short distance in any direction required to recenter the picture. DO NOT use undue force in making this adjustment as excessive strain may be exerted on the neck of the picture tube. If proper centering cannot be restored in this manner, a slight readjustment of the deflection yoke mounting may be necessary.

TEST PATTERNS COURTESY RCA SERVICE CO.

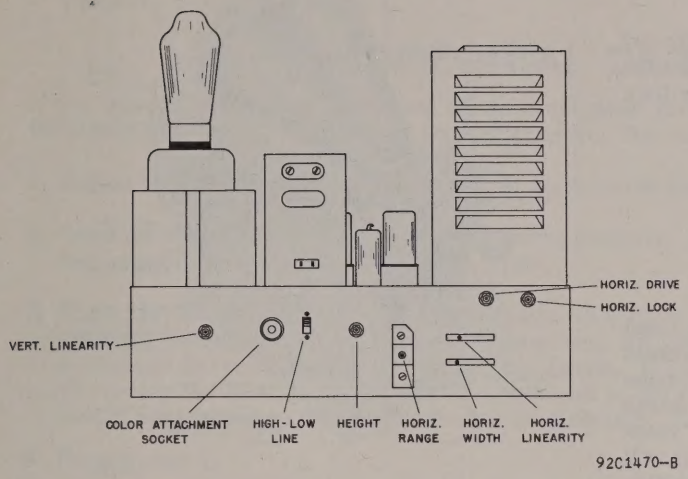


Fig. 4. D900D Chassis Rear View

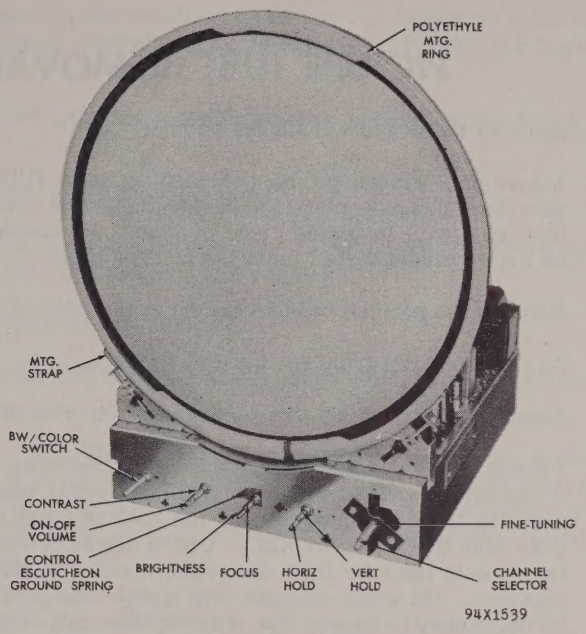


Fig. 5. D900D Chassis Front View

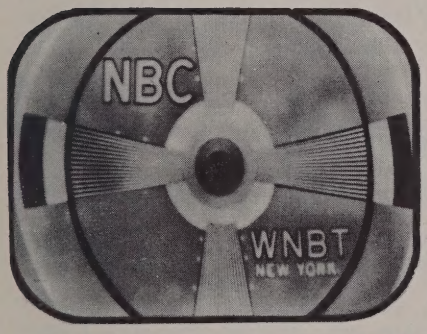


Fig. 6. Improper Height Control Setting

Fig. 7. Improper Width Control Setting

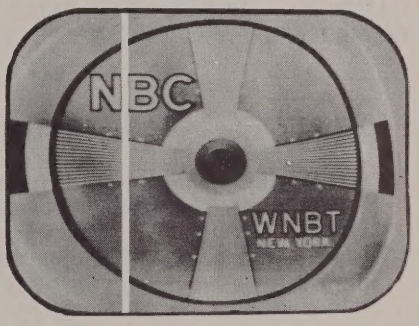


Fig. 8. Improper Horizontal Drive Control Setting

Adjust the HEIGHT and WIDTH controls so that the picture fills out the dimensions of the screen. A slight readjustment of the CENTERING control may then be necessary.

Adjust the HORIZONTAL DRIVE by advancing the control until a vertical white line (Fig. 8) appears in the pattern. Then turn the control in the opposite direction just a little further beyond the point at which the line disappears. If, after setting the HORIZONTAL DRIVE control, the HORIZONTAL HOLD control on the front panel fails to restore synchronization it will be necessary to adjust the horizontal oscillator as described on page 7.

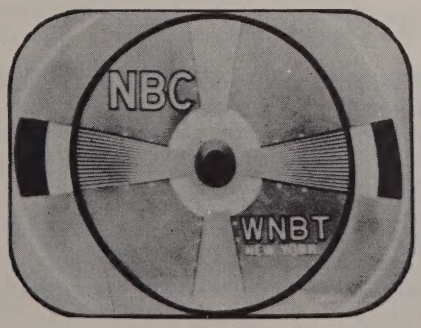


Fig. 9. Improper Horizontal Linearity Control Setting

Fig. 10. Improper Vertical Linearity Control Setting

Adjust the HORIZONTAL LINEARITY and VERTICAL LINEARITY controls for a symmetrical pattern. A slight readjustment of the HEIGHT and WIDTH controls may then be necessary.

TEST PATTERNS COURTESY RCA SERVICE CO.

PICTURE TUBE REMOVAL

1. Remove the chassis from the cabinet.

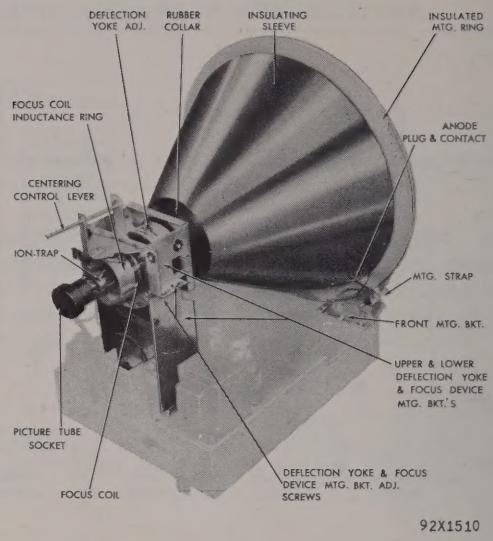
2. Insure the discharge of the high voltage filter capacitor by shorting the anode plug (PL-104) or the metal cone to the chassis through a well insulated piece of wire. The anode lead may then be safely disconnected from the picture tube.

3. Remove the picture tube socket from the base of the tube.

4. Slip the ion trap from the neck of the tube.

5. Remove the mounting strap from the front rim of the tube.

6. Loosen the four rear support adjustment screws. Raise the front of the tube just far enough to clear the front mounting brackets and slip the tube forward until the neck is clear of the deflection yoke and the rubber collar. Use a slight twisting pull to break the cone of the tube from the rubber collar if the two are stuck together. On some chassis with metal cone picture tubes it will be necessary to loosen the polyethylene mounting ring and disconnect the anode lead by pulling the strap to which it is soldered from under the mounting ring.



Picture Tube Mounting Detail

CAUTION -- IF THE TUBE FAILS TO SLIP OUT EASILY, INVESTIGATE AND REMOVE THE CAUSE OF TROUBLE. DO NOT USE FORCE AS THE NECK OF THE PICTURE TUBE IS EASILY BROKEN.

PICTURE TUBE INSTALLATION AND ADJUSTMENT

1. Slip the insulating sleeve over the cone of the tube and fit the polyethylene mounting ring around the front rim of the tube and over the insulating sleeve. Position the mounting ring on the tube so that the joint in the ring will be at the bottom and the anode contact will be on the left side when the tube is viewed from the front face. In some cases where the anode lead is soldered directly to the anode contact strap, it will be necessary to slide the strap under the polyethylene mounting ring after the tube has been inserted in the chassis.

2. Slide the neck of the picture tube through the rubber collar and deflection yoke. Seat the groove of the polyethylene mounting ring on the two rubber strips which are attached to the front tube mounting brackets. The joint in the polyethylene mounting ring should be at the bottom center of the picture tube.

3. Place the mounting strap around the groove in the polyethylene mounting ring or around the rubber strip depending upon the type of tube and tighten the screws on each end of the mounting strap.

4. Move the rear support so that the rubber collar rests firmly against and supports the cone of the tube. Tighten the rear support adjustment screws.

5. Check the ion trap for any marking and slip the trap over the neck of the tube. If the trap is stamped with an arrow, the arrow should point towards the face of the tube.

6. Connect the picture tube socket and the anode plug (PL-104) and turn the receiver on.

7. Turn up the brightness control and set the ion trap for maximum raster brilliance, backing off the brightness control as the maximum point is approached. The ion trap must be rotated about the axis of the tube as well as shifted along the neck to obtain the proper setting. With the brightness control set for slightly above normal brilliance and the contrast control full counterclockwise, adjust the focus control until the lines of the raster are clearly visible. Readjust the brightness control for normal brightness and touch up the ion trap setting.

8. Connect the antenna and tune in a test pattern.

9. Readjust the contrast control until the different shades of the gray scale are clearly visible on the test pattern.

10. Check the position and appearance of the test pattern. If it is off center or shadowed at the corners, adjust the centering lever. If required, the focus coil inductance ring should be adjusted. Set the focus control on the front apron of the chassis in the approximate center of the range over which it may be rotated and adjust the focus coil inductance ring as necessary to obtain a sharp clear picture well within the range of the focus control. A slight readjustment of the ion trap may then be necessary.

11. If the lines of the raster are not horizontal or square with respect to the escutcheon, loosen the deflection yoke adjustment thumb screw and rotate the deflection yoke until the proper raster position is obtained. Tighten the thumb screw after adjusting the yoke.

12. Follow the procedure under "SERVICE ADJUSTMENTS" and make any minor adjustments necessary to obtain a properly adjusted pattern.

HORIZONTAL OSCILLATOR ADJUSTMENT

If the HORIZONTAL HOLD control on the front panel fails to restore synchronization, the HORIZONTAL RANGE and HORIZONTAL LOCK adjustments should be reset. Procedure for these adjustments is as follows:

1. Adjust the HORIZONTAL DRIVE control as directed under "SERVICE ADJUSTMENTS".

2. Turn the HOLD control to the full clockwise position. Adjust the HORIZONTAL RANGE adjustment until a vertical bar appears in the pattern. See Fig. 12B.

3. Turn the HOLD control to the full counterclockwise position. With the CHANNEL SELECTOR set to an active channel, momentarily set it to an adjacent one, and then return it to its original position. Three or four nearly horizontal bars should now appear on the screen. If too many or two few bars appear, the number may be decreased by turning the HORIZONTAL LOCK adjustment in the clockwise direction, or increased by turning the HORIZONTAL LOCK adjustment in the counterclockwise direction. See Fig. 12A.

4. Repeat step 1.

5. Check the action of the front controls on all active channels. Repeat the first three steps if necessary, to maintain stable synchronization.

If the above procedure fails to restore stable synchronization, make proper horizontal oscillator waveform adjustments with the aid of an oscilloscope.

6. Connect the oscilloscope as shown in Fig. 11. Adjust the TERTIARY WAVEFORM adjustment until the sine wave is equal in amplitude to the peak of the sawtooth. See Fig. 12C. Vary the HORIZONTAL RANGE adjustment to keep the picture synchronized.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious.

On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pullin range becomes inadequate and the broad peak can cause double triggering of the oscillator when the HOLD control approaches the clockwise position.

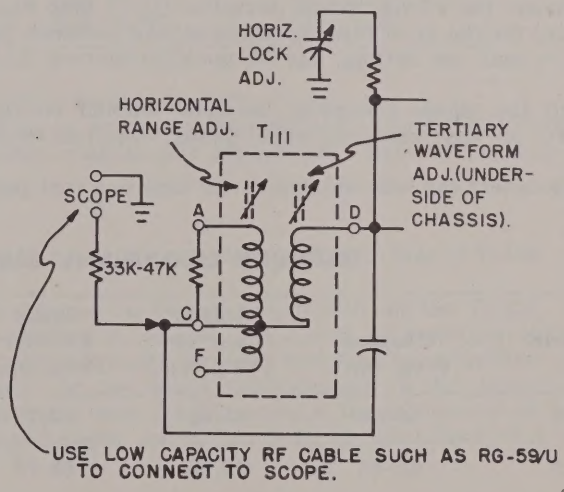
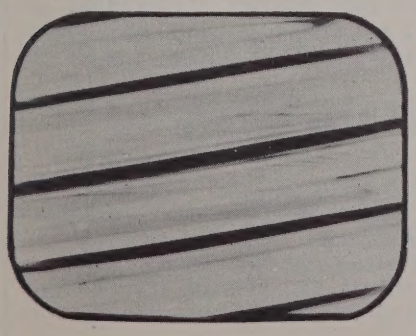
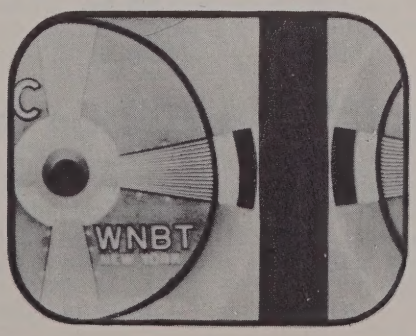


Fig. 11. Oscilloscope Connection for Horizontal Oscillator Alignment

7. Remove the oscilloscope and repeat steps 2 and 3 if necessary.

8. Check the action of the front panel controls and repeat the above steps as required to provide positive synchronization on all active channels.





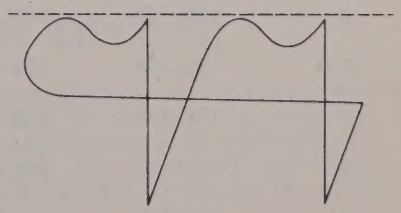


Fig. 12. Horizontal Oscillator Test Patterns and Waveform

FM SOUND CHANNEL ALIGNMENT

EQUIPMENT REQUIRED

Signal generator covering 4 to 30 mc

Vacuum tube voltmeter (VTVM)

1N34 crystal detector circuit as shown in Fig. 13

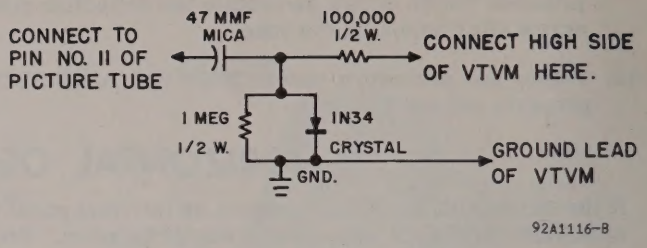


Fig. 13. Sound Alignment Test Circuit

PROCEDURE

1. Connect the signal generator output, through a .005 mfd. capacitor, to test terminal Ⓐ. (See Fig. 14.) Ground the shield of the generator output cable to the chassis, near terminal Ⓐ.

2. Connect the detector circuit and VTVM as shown in Fig. 13. Adjust the generator output (unmodulated) to give a 1 volt reading on the VTVM.

3. Adjust L-104, 4.5 MC TRAP ADJ., (see Fig. 14) at 4.5 mc for a minimum VTVM reading. Disconnect the test circuit.

4. Connect the VTVM to test terminal Ⓑ (Pin 2 of FM detector, V-110).

5. Adjust L-105, 4.5 MC LIMITER GRID ADJ., (see Fig. 14) and the primary of T-108 (bottom core) for a maximum VTVM reading.

6. Connect the VTVM to test terminal Ⓒ. (See Fig. 28, Schematic Diagram.) Adjust the secondary of T-108 (top core) for the zero reading which occurs between the positive and negative peaks. If the zero reading occurs at more than one setting, use the position nearest the top limit of the tuning core.

7. Shift the signal generator an equal amount on either side of 4.5 mc and touch up the primary of T-108 (bottom core) for approximately equal peaks. Use just enough signal output to obtain one volt peaks for best results.

8. Disconnect the test equipment and tune in a test pattern. Adjust L-104 for maximum vertical wedge definition.

TELEVISION CHANNELS vs. CARRIER, OSCILLATOR AND I-F FREQUENCIES

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)	Picture I-F Freq. (mc)	Sound I-F Freq. (mc)	Picture I-F less Sound I-F (mc)
2	54-60	55.25	59.75	81.5	26.25	21.75	4.5
3	60-66	61.25	65.75	87.5	26.25	21.75	4.5
4	66-72	67.25	71.75	93.5	26.25	21.75	4.5
5	76-82	77.25	81.75	103.5	26.25	21.75	4.5
6	82-88	83.25	87.75	109.5	26.25	21.75	4.5
7	174-180	175.25	179.75	201.5	26.25	21.75	4.5
8	180-186	181.25	185.75	207.5	26.25	21.75	4.5
9	186-192	187.25	191.75	213.5	26.25	21.75	4.5
10	192-198	193.25	197.75	219.5	26.25	21.75	4.5
11	198-204	199.25	203.75	225.5	26.25	21.75	4.5
12	204-210	205.25	209.75	231.5	26.25	21.75	4.5
13	210-216	211.25	215.75	237.5	26.25	21.75	4.5

I-F AMPLIFIER ALIGNMENT

1. Connect a VTVM between test terminal (A) and the chassis. (See Fig. 14.)

2. Connect the high side of a signal generator to the shield of the OSC./MIXER tube (6J6). This connection will capacitively couple the generator output to the tube. Make sure that the shield is ungrounded by raising it above the grounded clips that hold it in place. Connect the ground return of the generator to any chassis point near the base of the tube.

3. Set the CHANNEL SELECTOR to any vacant channel:

4. Set the signal generator output (unmodulated) for a two volt dc reading on the VTVM and adjust the three i-f transformers, L-113 and L-9, according to the I-F AMPLIFIER ALIGNMENT CHART shown below. Readjust the signal generator output as required to maintain the two volt potential at the VTVM.

I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment	Location	VTVM Indication
25.6 mc	T-102 (top)	Fig. 22	Maximum
23.1 mc	T-103 (top)	Fig. 22	Maximum
24.5 mc	T-104 (top)	Fig. 22	Maximum
21.75 mc	T-103 (bottom)	Fig. 25	Minimum
24.5 mc	*L-113	Fig. 22	Maximum
24.5 mc	**L-9	Fig. 22	Maximum

*NOTE: Hold the CHANNEL SELECTOR between two channels when making this adjustment.
**NOTE: Return the CHANNEL SELECTOR to the normal position on any vacant channel and shunt the 4700 ohm grid resistor (R-101) of V-101 with a 1000 ohm resistor, when making this adjustment. Remove resistor after adjustment is completed.

5. After adjusting the 21.75 mc sound trap (bottom slug of T-103), recheck the setting of the top slug of T-103.

6. Tune the signal generator from 21 mc through 26.25 mc and observe the change in indication on the VTVM. If the generator output is set to the level where a 1.5 volt meter reading is obtained at the peak i-f amplifier response, the reading should not drop below one volt between the two peaks normally obtained with this i-f amplifier. If the band-pass response is unsatisfactory, repeat the procedure or try slight modifications of the recommended settings to obtain the desired results. Avoid resonating the coils with the iron core at the bottom end of the coil form (adjustment screw near limit of its travel). Final adjustments can be made much more easily if a sweep type signal generator and oscilloscope are available.

7. Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response (approx. 0.15 volt) and the 26.25 mc response will fall approximately 6 db below the peak, (approx. .075 volt). Refer to Fig. 15.

To determine the i-f amplifier sensitivity, connect a signal generator to the OSC./MIXER tube as directed in step 2 of the I-F AMPLIFIER ALIGNMENT procedure. Set the generator frequency to either i-f peak. If a generator output of 800 to 1500 microvolts produces a one volt dc reading on a VTVM connected between terminal (A) and ground (Fig. 14), the i-f amplifier sensitivity is normal.

1D1055 TV TUNER ALIGNMENT (ANT. & RF CIRCUITS)

The tuner was carefully aligned at the factory and should not require complete realignment under normal operating conditions. A slight readjustment of the individual oscillator slugs may be required as the tubes in the tuner age or are replaced. In some rare cases it will be necessary to realign the tuner after replacing either of the two tubes. If any service work is performed on the tuner, realignment may or may not be required. NO ATTEMPT TO REALIGN THE TUNER SHOULD BE MADE UNTIL THE BALANCE OF THE TV RECEIVER IS KNOWN TO BE IN PROPER OPERATING CONDITION AND IS PROPERLY ALIGNED.

When replacing the rf amplifier tube, use the same type tube as the one found in the tuner. The other alternate tubes may be used for V-1 (page 3) but the use of a tube other than the type found in the tuner may make it necessary to realign the rf and mixer portion of the tuner.

EQUIPMENT REQUIRED

1. Sweep generator covering all 12 television channels.
2. Marker generator covering the same range as the sweep generator
3. Signal generator which has an output (unmodulated) on 26.25 mc
4. Oscilloscope
5. Vacuum tube voltmeter (VTVM)

SET-UP PROCEDURE

1. Set the CHANNEL SELECTOR switch to channel 12.
2. Connect the oscilloscope through a 10,000 ohm resistor to test point 9. (See Schematic Diagram).
3. Connect the negative pole of a 1.5 volt dry cell to the terminal where the AGC lead (white wire) from the tuner and one lead from R-101 are connected. Connect the positive pole of the dry cell to the receiver chassis. (See Schematic Diagram).
4. Set the FINE TUNING control at the approximate midpoint of its tuning range.
5. Connect the sweep generator to the antenna terminals and adjust the output to sweep channel 12.
6. Loosely couple the output from the marker generator to the antenna terminals. Use the minimum amount of coupling and signal from the marker generator required to give a good marker or pip on the oscilloscope pattern.

ANTENNA AND RF CIRCUIT ALIGNMENT

7. Adjust C-2, C-3 and C-4 for a flat-top response curve and maximum gain. Check markers on all channels. They should fall in automatically on each channel. Correct marker frequencies for each channel are given in the Picture Carrier and Sound Carrier columns of the chart on page 8.
8. Disconnect the battery used to obtain negative bias.
9. Disconnect the test equipment and air check the receiver on all active channels. If it is possible to receive a normal picture on all active channels by adjusting the FINE TUNING control, further alignment will not be necessary.

1D1055 TV TUNER ALIGNMENT (OSC. CIRCUIT)

1. Set the FINE TUNING control at the approximate midpoint of its tuning range.
2. Place a non-metallic screwdriver through the openings provided in the front of the chassis and the tuner assembly and adjust the oscillator coil slug for each active channel to give the best possible picture.

If the oscillator slug adjustment does not have sufficient range to tune in a good picture on any active channel it will be necessary to adjust C-5. The procedure for this adjustment is as follows:

WITH INSTRUMENTS

3. Set the CHANNEL SELECTOR switch to channel 12.
4. Connect the marker generator to one antenna terminal and ground. Set generator to 209.75 mc.
5. Connect the output of another signal generator to point (A) through a 47,000 ohm resistor and adjust the generator frequency to 26.25 mc.
6. Connect the VTVM to point (C) (See Schematic) and adjust C-5 for a zero reading on the VTVM between a positive and negative peak.
7. Use only sufficient output from the signal generators to obtain a useable meter reading.
8. Repeat steps 1 and 2.
9. Repeat steps 3 through 8 if necessary.

WITHOUT INSTRUMENTS

3. Set the CHANNEL SELECTOR switch to any active channel on which a picture or test pattern can be received. Preferably select a station operating on the highest frequency or channel.
4. Adjust C-5 for the best possible picture.
5. Repeat steps 1 and 2.
6. Repeat steps 3 through 5 if necessary.

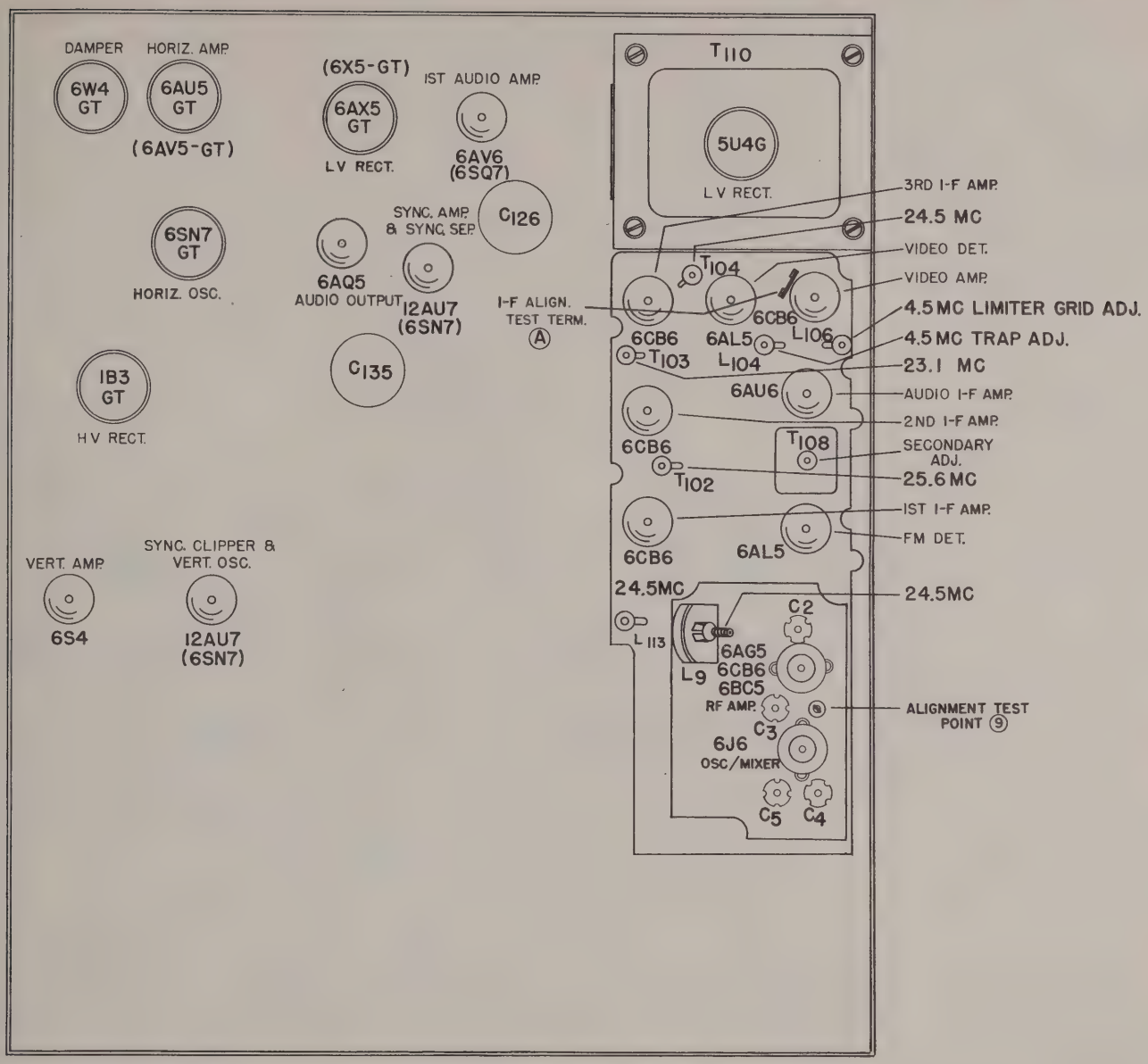


Fig. 14. Top View Alignment Locations

92D1178-M
92A1342-C

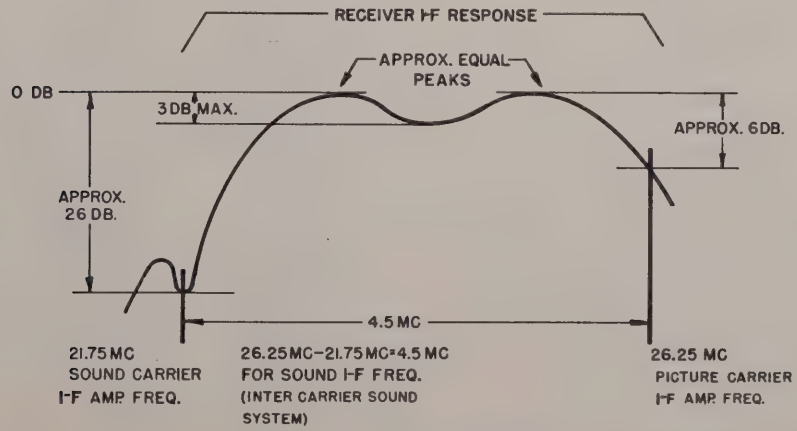

RECEIVER I-F RESPONSE
APPROX. EQUAL PEAKS
0 DB
3 DB MAX.
APPROX. 6 DB.
APPROX. 26 DB.
4.5 MC
21.75 MC SOUND CARRIER I-F AMP. FREQ.
26.25 MC-21.75 MC=4.5 MC FOR SOUND I-F FREQ. (INTER CARRIER SOUND SYSTEM)
26.25 MC PICTURE CARRIER I-F AMP. FREQ.

Fig. 15. I-F Amplifier Response

92B1084-B

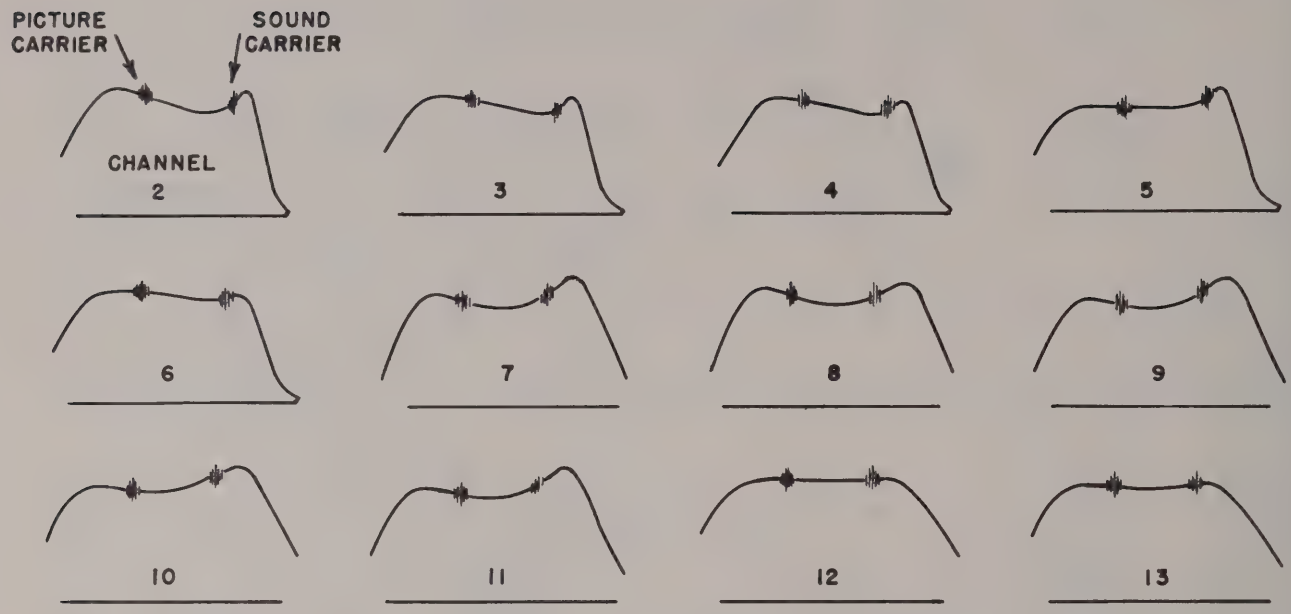


Fig. 16. Tuner Channel Response Curves 9281166

SERVICE PARTS LIST FOR 1D1055 TUNER

Hallicrafters Part Number	Description
121A001	Fine tuning assembly shaft & cam
121A002	Drum & shaft assembly, less coils
121A003	Channel 2, antenna coil
121A004	Channel 3 antenna coil
121A005	Channel 4 antenna coil
121A006	Channel 5 antenna coil
121A007	Channel 6 antenna coil
121A008	Channel 7 antenna coil
121A009	Channel 8 antenna coil
121A010	Channel 9 antenna coil
121A011	Channel 10 antenna coil
121A012	Channel 11 antenna coil
121A013	Channel 12 antenna coil
121A014	Channel 13 antenna coil
121A015	Channel 2 r-f & osc. coil
121A016	Channel 3 r-f & osc. coil
121A017	Channel 4 r-f & osc. coil
121A018	Channel 5 r-f & osc. coil
121A019	Channel 6 r-f & osc. coil
121A020	Channel 7 r-f & osc. coil
121A021	Channel 8 r-f & osc. coil
121A022	Channel 9 r-f & osc. coil
121A023	Channel 10 r-f & osc. coil
121A024	Channel 11 r-f & osc. coil
121A025	Channel 12 r-f & osc. coil
121A026	Channel 13 r-f & osc. coil
121A027	Detent roller
121A028	Fiber washer
121A029	Spring, fine tuning ground
121A030	Spring, shaft retaining (2 req.)
121A031	Spring, detent
121A032	L-9 peaking coil
121A033	Slug, osc. coil adjustment
121A034	Spring, osc. coil slug retaining
121A035	Stator contact assembly
121A036	Fine tuning capacitor plate
121A037	Spring, detent ground

NOTE: The last two numbers of the part numbers shown in the Service Parts List are used to identify the corresponding part in the illustration on the following page.

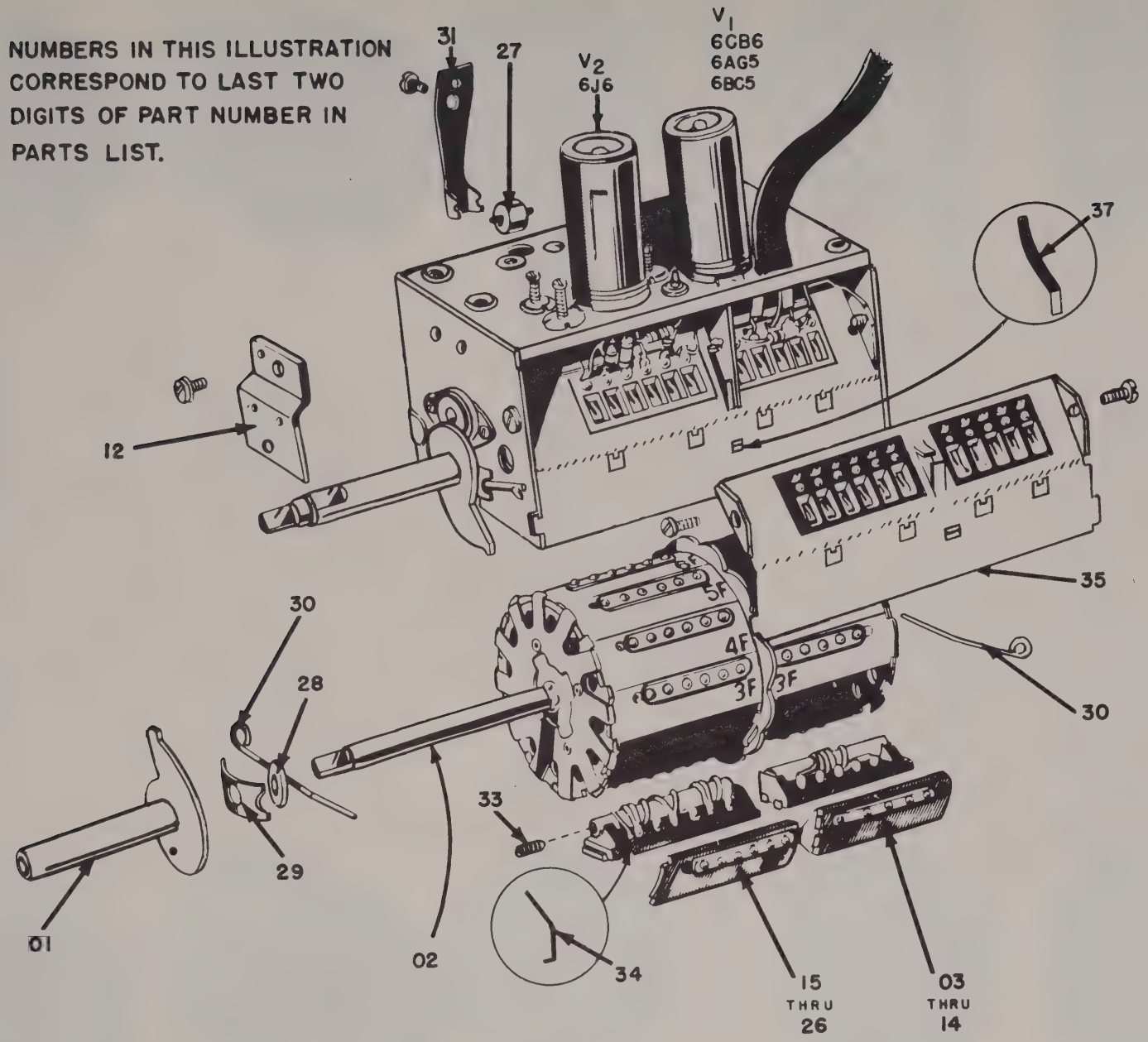


Fig. 17. 1D1055 Tuner Replaceable Parts

TYPICAL OSCILLOSCOPE PATTERNS

The patterns given on the following pages are presented as a guide when using an oscilloscope to locate trouble in the video amplifier, sync., horizontal oscillator, horizontal output, vertical oscillator, and vertical output stages of the tv receiver.

Considerable variation may be noted in the amplitude and shape of some of the various waveforms from one receiver to the next. As long as the waveform obtained from the receiver under test contains the same general characteristics as those shown in the illustrations and the relative amplitude is within approximately 25% of the peak to peak voltage or relative amplitude shown below each waveform the pattern obtained may be assumed to be correct. The patterns are observed with the tv receiver tuned to an active channel and the controls adjusted for the best possible picture.

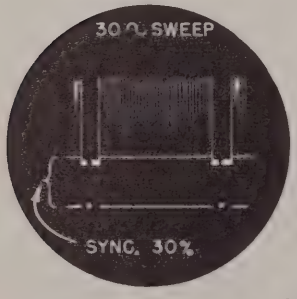
The waveforms shown in the illustrations were obtained on a Dumont type 304 oscilloscope which was used in conjunction with a low capacity 10 to 1 probe such as the Tel-Instrument Co. type 1610. Other types of oscilloscopes will account for a certain amount of variation in the amplitude and shape of the patterns obtained from the actual receiver under test. A low capacity probe must be used in order to obtain satisfactory results.

With the exception of the test pattern obtained across the vertical yoke all patterns are taken with the ground side of the oscilloscope connected to the ground or chassis of the tv chassis and the 10 to 1 probe connected to the specific points in the tv chassis as specified by each pattern.

The patterns obtained from the horizontal amplifier plate, damper cathode, horizontal output transformer, and the high voltage rectifier tube must be observed by means of the high voltage probe which is made from a type 1X2-A tube as shown in Fig. 18. The tube is used as a high voltage coupling capacitor. Use a new tube for this application because the loose filament of a burned out one may touch the plate. These patterns are also shown with their relative amplitudes indicated with respect to the pattern obtained at terminal (or tap) 4 of T-112 which is given a unit value of one.

At certain points throughout the tv receiver the oscilloscope pattern obtained will be dependent upon the frequency of the horizontal sweep oscillator in the oscilloscope. The oscilloscope sweep frequency must be either 30 cps (1/2 of the tv vertical oscillator frequency) or 7875 cps (1/2 of the tv horizontal oscillator frequency) depending upon the pattern desired. The sweep frequency required to obtain the patterns shown is given with each pattern.

VIDEO AMPLIFIER



92C1500
1

V-105 Video Amp. grid (Pin 1)

V-105 Video Amp. plate (Pin 5) Adjust the contrast control to give a 40 volt peak to peak reading.

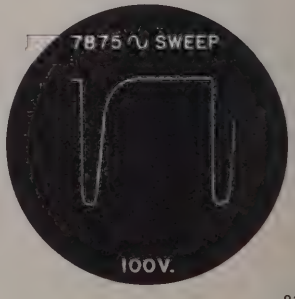
92C1500
7

SYNC. AMPLIFIER, SEPARATOR AND CLIPPER

92C1500
8

V-106 Sync. Amp. grid (Pin 2)

V-106 Sync. Amp. plate (Pin 1)



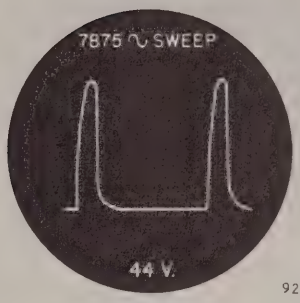
92C1500
9

SYNC. AMPLIFIER, SEPARATOR AND CLIPPER (Cont.)

92C1500
10

V-106 Sync.
Sep. plate (Pin 6)

V-107 Sync.
Clipper Plate (Pin 1)



92C1501
4

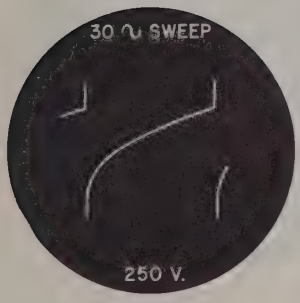
92C1501
2

Input to Vertical
Integrating Network
(CRL-101)

Cathode Ray Tube
V-119 grid (Pin 2)

92C1501
3

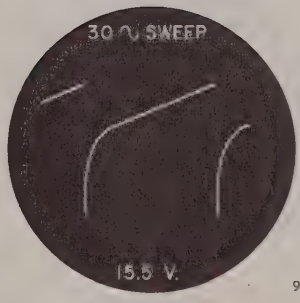
VERTICAL OSCILLATOR AND VERTICAL AMPLIFIER



92C1502
3

V-107 Vert.
Osc. grid (Pin 7)

V-107 Vert.
Osc. plate (Pin 6)

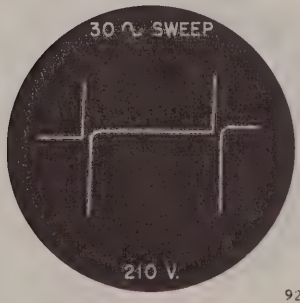


92C1502
4

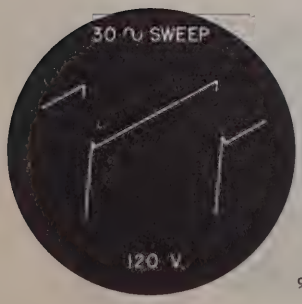
92C1502
1

T-106 Vert. Osc.
Transformer
Yellow lead

T-106 Vert. Osc.
Transformer
Green lead



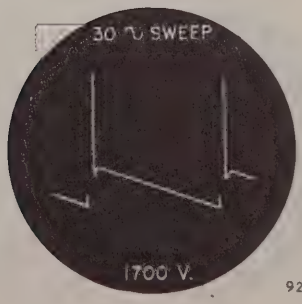
92C1502
2



92C1502
9

V-108 Vert.
Amp. grid (Pin 6)

V-108 Vert.
Amp. plate (Pin 9)



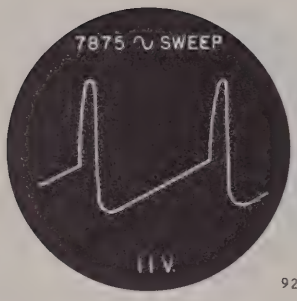
92C1502
5

92C1502
10

Vert. Deflection Yoke
(Connect to Red and
Green wires of T-107)

NOTE: When observing this test pattern the oscilloscope must not be grounded since the ground side of the 'scope is connected to B+ of the tv power supply. Do not touch the tv chassis and the 'scope during this observation as a severe shock will result.

HORIZONTAL OSCILLATOR



92C1503
2

Junction of C-119,
C-151 and C-156

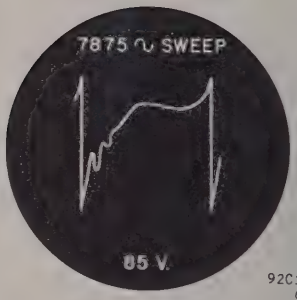
V-115 Horiz. Osc.
grid (Pin 1)

92C1503
3

92C1503
5

V-115 Horiz. Osc.
cathode (Pin 3)

Junction of R-168, R-169,
R-170, and R-173



92C1503
6

92C1503
7

V-115 Horiz. Osc.
grid (Pin 4)

V-115 Horiz. Osc.
plate (Pin 5)

92C1503
8

92C1503
9

Horiz. Osc. Trans.
T-111 Terminal C

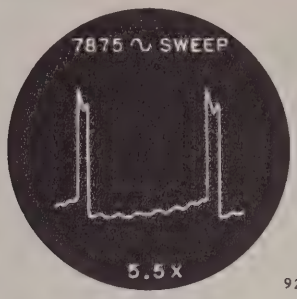
Horiz. Osc. Trans.
T-111 Terminal D

92C1503
10

HORIZONTAL AMPLIFIER, HORIZONTAL OUTPUT TRANSFORMER, DAMPER, AND HIGH VOLTAGE RECTIFIER

NOTE: Before endeavoring to view the following waveforms read the notes and instructions at the beginning of this section pertaining to waveforms. The high voltage probe shown below will have to be used.

V-116 Horiz. Amp. plate (Pin 5)

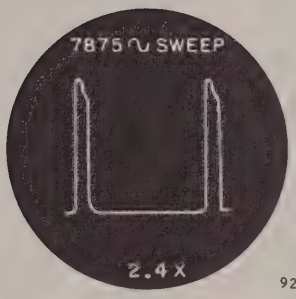


92C1504 7

92C1504 1

Horiz. Output Trans. T-112 Terminal 4

Horiz. Output Trans. T-112 Terminal 5



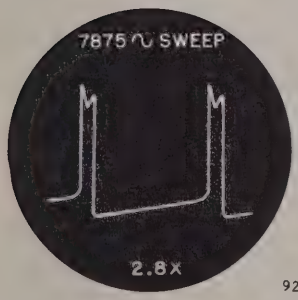
92C1504 2

92C1504 3

Horiz. Output Trans. T-112 Terminal 7

Horiz. Output Trans. T-112 Terminal 8

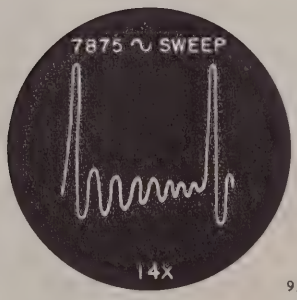
92C1504 5



92C1504 4

V-117 Damper cathode (Pin 3)

V-118 High Volt. Rect. plate (cap)



92C1504 6

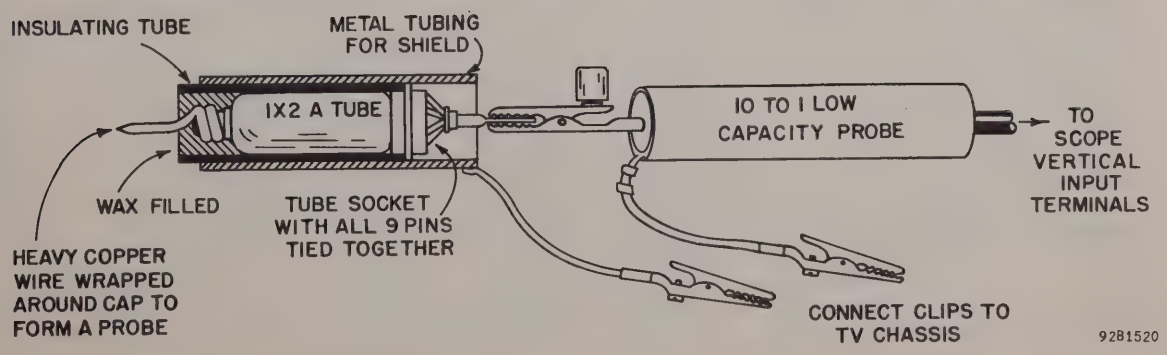

INSULATING TUBE
METAL TUBING FOR SHIELD
1X2 A TUBE
10 TO 1 LOW CAPACITY PROBE
TO SCOPE VERTICAL INPUT TERMINALS
WAX FILLED
TUBE SOCKET WITH ALL 9 PINS TIED TOGETHER
HEAVY COPPER WIRE WRAPPED AROUND CAP TO FORM A PROBE
CONNECT CLIPS TO TV CHASSIS
92B1520

Fig. 18. High Voltage Probe for Waveform Observations

SERVICE PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
	TRANSFORMERS AND COILS	
T-102	Transformer, 1st i-f amplifier	50A475
T-103	Transformer, 2nd i-f amplifier	51B1332 or 50A476
T-104	Transformer, 3rd i-f amplifier	50A477
T-106	Transformer, vertical oscillator	55C115
T-107	Transformer, vertical output	55B151
T-108	Transformer, ratio detector	50C473
T-109	Transformer, audio output	55B150
T-110	Transformer, power	52C204
T-111	Transformer, horizontal oscillator	51B1242
T-112	Transformer, horizontal output	55C149
L-101	Coil, video peaking (wound on R-113)	51A1256
L-102	Coil, video peaking (wound on R-114)	51A1260
L-103	Coil, video peaking (wound on R-120)	51A1257
L-104,106	4.5 MC TRAP, LIMITER GRID adjustment	51B1333 or 50B474
L-105	Coil, video peaking (wound on R-121)	51A1259
L-107	Coil, FOCUS	51B1287
L-108	Deflection yoke	53-237
L-109	Choke, filter	56C116
L-110	Coil, HORIZONTAL LINEARITY	51B1331 or 51B1340
L-111	Coil WIDTH control	51B1330 or 51B1341
L-112	Choke, heater	53A200
L-113	Coil, mixer i-f	51B1301
L-114	Choke, r-f	53B008
	CAPACITORS	
CRL-101	Vertical integrating network	49A015
CRL-102	Audio coupling network	49A017
C-101,102,103, 104,106,107, 121,163,164	5000 mmf. 450 V., ceramic	47A168
C-108	10 mmf. 500 V., ceramic	47B20100K5
C-109,110	.5 mfd. 25 V., tubular	46A177
C-111	100 mfd. 10 V., electrolytic	45B170
C-112	2.2 mmf. 500 V., ceramic	47A160-4
C-113,128	47 mmf. 500 V., ceramic (part of L-104 & L-106)	---
C-114	220 mmf. 500 V., mica	47X20B221K
C-115,116,143, 146,155,165	.05 mfd. 600 V., tubular	46AY503J
C-117	68 mmf. 500 V., ceramic	47B20680K5
C-118	Dual 10 mfd. 450 V., electrolytic	45A172
C-119	120 mmf. 500 V., mica	47X20B121K
C-120,144	.5 mfd. 200 V., tubular	46AT504J
C-122,130	1000 mmf. 500 V., ceramic	47B20A102M5
C-123	6800 mmf. 500 V., mica	47X35B682K
C-124,134,136, 138	.01 mfd. 600 V., tubular	46AY103J
C-125	.047 mfd. 600 V., tubular	46BR473L6
C-126	60-40 mfd. 450 V., 75 mfd. 50 V., electrolytic	45B173
C-127,158,161	.1 mfd. 600 V., tubular	46AX104J
C-129	Dual 4000 mmf. 450 V., ceramic	47A218
C-132,154	5 mfd. 50 V., electrolytic	45B175
C-133	330 mmf. 500 V., ceramic	47B20331K4 or 47B20A331M5
C-135	40-40 mfd. 250 V., 40 mfd. 450 V., 20 mfd. 25 V., electrolytic	45B174
C-137	.1 mfd. 200 V., tubular	46AU104J
C-139	56 mmf. 500 V., mica (part of L-108)	---
*C-141,142	.01 mfd. 600 V., tubular	46BR103J6 or 46A178
C-145	.02 mfd. 600 V., tubular	46AY203J
C-147,156	330 mmf. 500 V., mica	47X20B331K
*C-148	.01 mfd. 400 V., tubular	46BR103E4
C-149	Trimmer, HORIZONTAL LOCK control	44A391
C-150,151	82 mmf. 500 V., mica	47X20B820K
C-152	820 mmf. 500 V., mica	47X25B821K
C-153	4700 mmf. 500 V., mica	47X35B472K
C-157,159	.03 mfd. 600 V., tubular	46AY303J
C-160	8 mfd. 475 V., electrolytic	45A103
C-162	500 mmf. 20,000 V., ceramic	47A223
C-166	.05 mfd. 200 V., tubular	46AU503J
C-167	5 mmf. 500 V., ceramic	47B20050K5

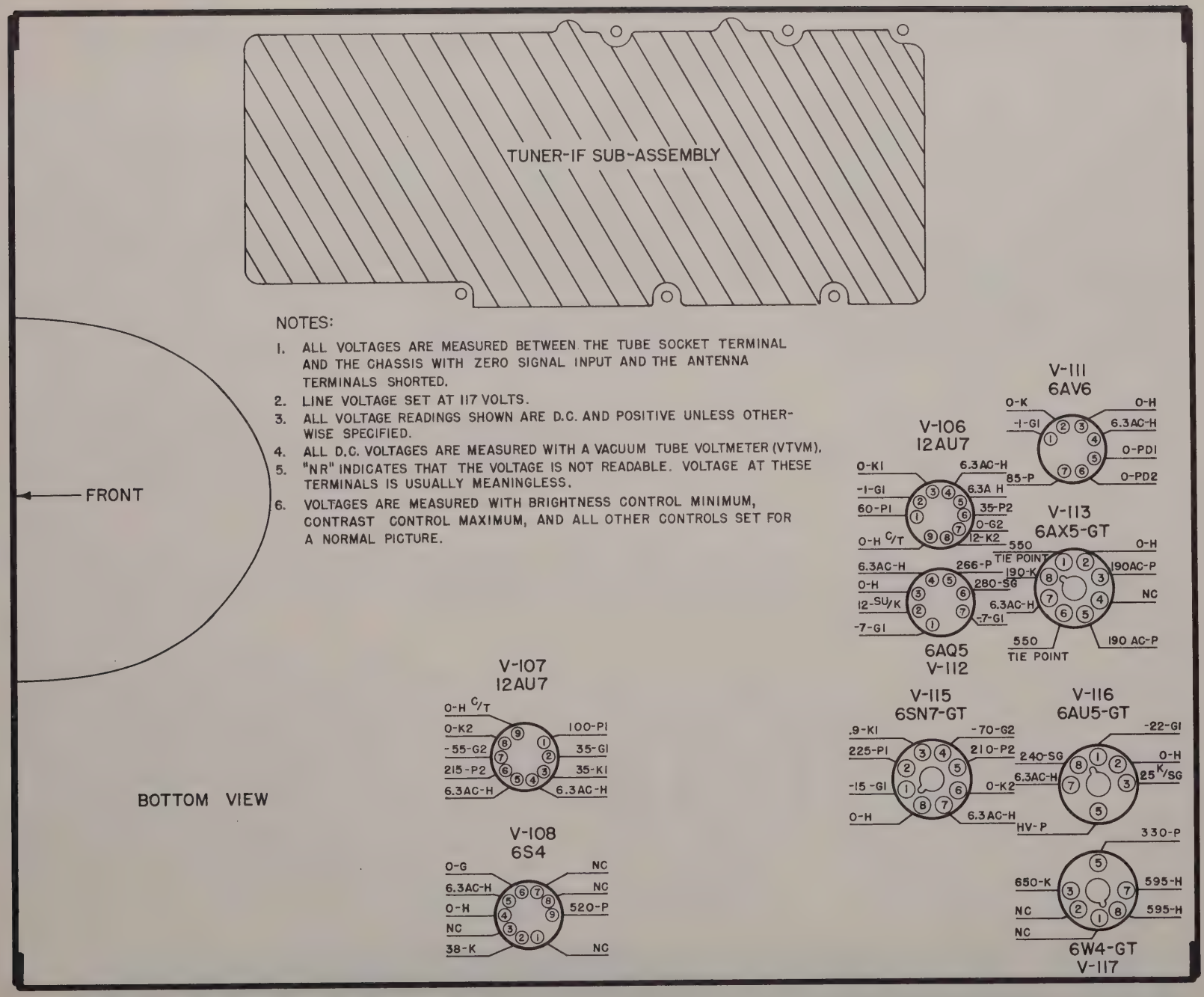
Schematic Symbol	Description	Hallicrafters Part Number
	RESISTORS	
R-101,134,163	4700 ohms 1/2 watt, carbon	23X20X472K
R-102,108,110, 111	100 ohms 1/2 watt, carbon	23X20X101K
R-103,106,112, 118,147	150 ohms 1/2 watt, carbon	23X20X151K
R-104,107,180	47 ohms 1/2 watt, carbon	23X20X470K
R-105,174	12,000 ohms 1/2 watt, carbon	23X20X123K
R-109,122,137	10,000 ohms 1/2 watt, carbon	23X20X103K
R-113	6800 ohms 1/2 watt, carbon (part of L-101)	---
R-114,121	2200 ohms 1/2 watt, carbon (part of L-102 & L-105)	---
R-115,145	1 megohm 1/2 watt, carbon	23X20X105M
R-116	3300 ohms 1/2 watt, carbon	23X20X332K
R-117,123	220,000 ohms 1/2 watt, carbon	23X20X224M
R-119,154	1 megohm/2500 ohms; OFF-ON-VOLUME/CONTRAST control	25B898
R-120	15,000 ohms 1/2 watt, carbon (part of L-103)	---
R-124	2.2 megohms 1/2 watt, carbon	23X20X225M
R-125,194	270,000 ohms 1/2 watt, carbon	23X20X274M
R-126,132,138	47,000 ohms 1/2 watt, carbon	23X20X473K
R-127	5600 ohms 2 watts, carbon	23X40X562K
R-128	820,000 ohms 1/2 watt, carbon	23X20X824M
R-129,131,193	2200 ohms 1/2 watt, carbon	23X20X222K
R-130	6800 ohms 1/2 watt, carbon	23X20X682K
R-133	15,000 ohms 2 watts, carbon	23X40X153K
R-135	1500 ohms 1 watt, carbon	23X30X152K
R-136,159	2500/50,000 ohms; FOCUS-BRIGHTNESS control	25B895
R-140,171	1 megohm/50,000 ohms; VERTICAL-HORIZONTAL HOLD control	25B917
R-141	5000 ohms; VERTICAL LINEARITY control	25B712
R-142,175	8200 ohms 1/2 watt, carbon	23X20X822K
*R-143	1 megohm 1 watt, carbon	23X30BF105M
R-144	1000 ohms 1 watt, carbon	23X30X102K
R-146	2.5 megohms; HEIGHT control	25B711
R-148	22,000 ohms 1/2 watt, carbon	23X20X223K
R-149	270 ohms 1/2 watt, carbon	23X20X271K
R-150	33,000 ohms 1/2 watt, carbon	23X20X333K
*R-151,152	10,000 ohms 1/2 watt, carbon	23X20X103J
R-153	10 megohms 1/2 watt, carbon	23X20X106M
R-155	270 ohms 1 watt, carbon	23X30X271K
R-156	15,000 ohms 10 watts, WW; flat	24A922
R-157	100,000 ohms 1/2 watt, carbon	23X20X104M
R-158	1000 ohms 5 watts, WW; flat	24A921
R-160,162	560 ohms 1/2 watt, carbon (part of L-108)	---
R-161	1000 ohms 1/2 watt, carbon (part of L-108)	---
R-164	750 ohms 10 watts, WW; flat	24A920
R-165	3900 ohms 1/2 watt, carbon	23X20X392K
*R-166	120,000 ohms 1 watt, carbon	23X30BF124K
R-167,177	330,000 ohms 1/2 watt, carbon	23X20X334K
R-168,191	820,000 ohms 1/2 watt, carbon	23X20X824K
R-169	82,000 ohms 1 watt, carbon	23X30X823K
*R-170	330,000 ohms 1 watt, carbon	23X30BF334J
R-172	68,000 ohms 1/2 watt, carbon	23X20X683K
R-173	150,000 ohms 1/2 watt, carbon	23X20X154K
R-176	50,000 ohms, HORIZONTAL DRIVE control	25A858
*R-178	47,000 ohms 1 watt, carbon	23X30BF473K
R-179,192	470,000 ohms 1/2 watt, carbon	23X20X474M
*R-181	220 ohms 3 watts, WW	24A925
*R-182	200 ohms 5 watts, WW	24A926
R-183	2200 ohms 1 watt, carbon	23X30X222K
R-184	3.3 ohms 1/2 watt, carbon	23X20X033K
R-185	1 megohm 1 watt, carbon	23X30X105M
R-186	150,000 ohms 1/2 watt, carbon	23X20X154M
R-187	680 ohms 1/2 watt, carbon	23X20X681M
R-188	20 ohms 7.5 watts, WW	24A947

* USE EXACT REPLACEMENT PART ONLY

SERVICE PARTS LIST

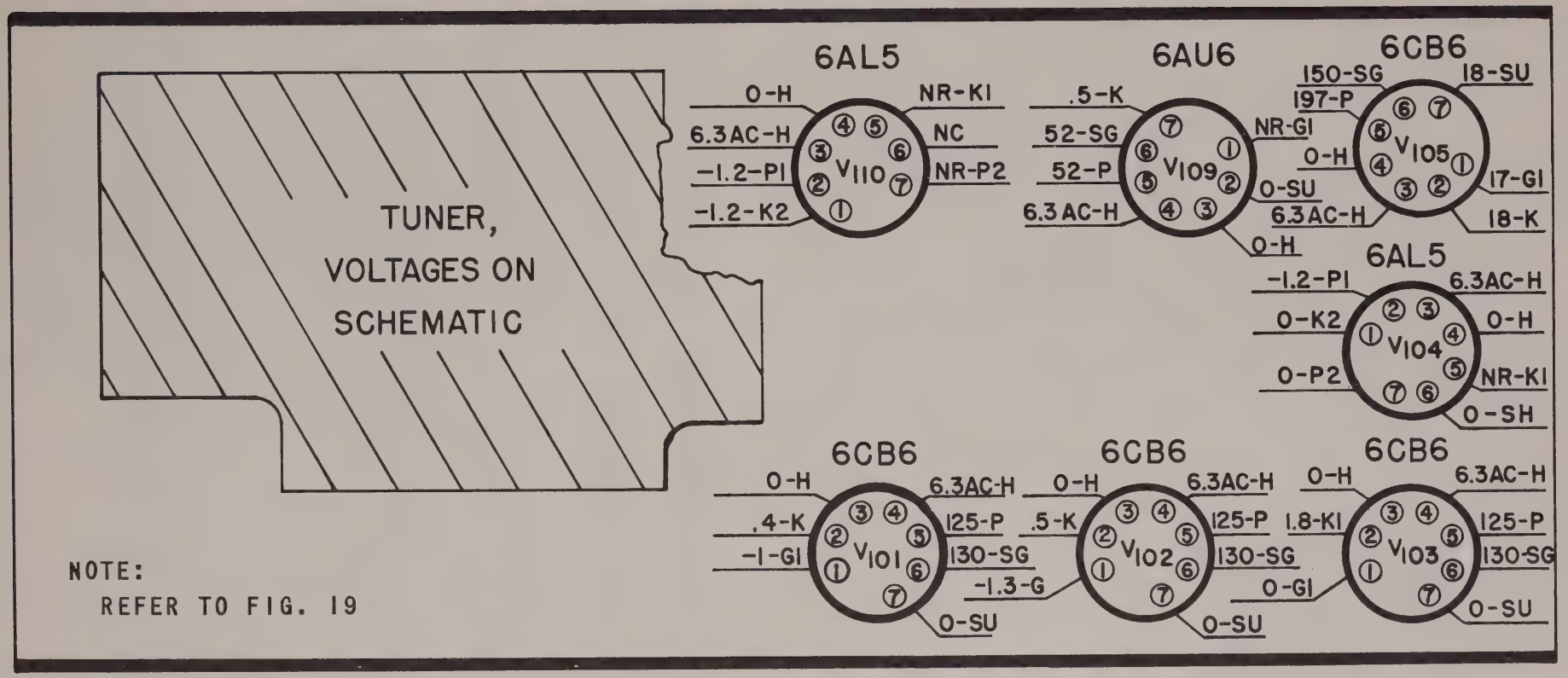
Schematic Symbol	Description	Hallicrafters Part Number
	TUBE COMPLEMENT	
V-1	6CB6; r-f amplifier (part of TV tuner)	---------
V-2	6J6; oscillator/mixer (part of TV tuner)	---------
V-101,102,103, 105	6CB6; 1st, 2nd, and 3rd i-f amplifiers and video amplifier	90X6CB6
V-104,110	6AL5; video and f-m detectors	90X6AL5
V-106,107	12AU7; sync. amp. and sep. - sync. clipper and vert. oscillator or	90X12AU7
	6SN7-GT: same as above	90X6SN7-GT
V-108	6S4; vertical amplifier	90X6S4
V-109	6AU6; audio i-f amplifier	90X6AU6
V-111	6AV6; audio amplifier or	90X6AV6
	6SQ7; audio amplifier	90X6SQ7
V-112	6AQ5; audio output	90X6AQ5
V-113	6AX5-GT; low voltage rectifier	90X6AX5-GT
V-114	5U4G; low voltage rectifier	90X5U4G
V-115	6SN7-GT; horizontal oscillator	90X6SN7-GT
V-116	6AU5; horizontal amplifier	90X6AU5
V-117	6W4-GT; damper	90X6W4-GT
V-118	1B3-GT; high voltage rectifier	90X1B3-GT
V-119	19AP4; picture tube	90X19AP4
	MISCELLANEOUS PARTS	
	Bracket, deflection yoke and focus coil mtg. (lower)	67D1248
	Bracket, deflection yoke and focus coil mtg. (upper)	67D1348
	Bracket, deflection yoke mtg. (mtd. on 67D1348)	67C1244
	Bracket, mounting for TS-101 and SO-101	67C1447
	Bracket, picture tube mtg.; front right	67D1263
	Bracket, picture tube mtg.; front left	67D1262
	Collar, picture tube mtg.; rubber (mtd. in front of deflection yoke)	16C202
	Channel, rubber; for front pix tube mtg. bkts.	16A205
F-101	Fuse, 1/4 amp. 125 V., slow blow	39A344
	Ion trap	21A101
	Lever, centering control	74B342
	Plate, anode keeper	8A1382
	Plate, tuner access	8B1305
PL-105	Plug, 9 pin; color adapter	10A299
	Ring, mounting; polyethylene	8D1060
	Shell for PL-105	69A369
	Sleeve, insulating; polyethylene	8D1059
SO-101	Socket, a-c power	10A286

Schematic Symbol	Description	Hallicrafters Part Number
	MISCELLANEOUS PARTS (Cont.)	
	Socket assembly, high voltage rectifier tube	6A355
	Socket, miniature 7 pin; 1 5/8" mounting center	6B314
	Socket, miniature 7 pin; 1 1/4" mounting center	6A340
	Socket, miniature 9 pin; 1 5/16" mounting center	6A388
	Socket, miniature 9 pin; 1 1/8" mounting center	6A334
	Socket, miniature 9 pin tube; molded mica filled	6A360
SO-105	Socket, 9 pin; color adapter	6A370
	Socket, octal; molded	6B296
	Socket, octal; molded mica filled	6A373
	Socket, picture tube	6A386
SO-103	Socket, speaker	10A373
	Spring, front control escutcheon ground	75B194
	Strap, picture tube mtg.	76B598
S-103	Switch, s.p.s.t. (HIGH-LOW-LINE)	60A249
S-101	Switch, OFF/ON (part of R-154)	- - - -
S-102	Switch, BW/COLOR 60B435, 60B428 or	60B390
TS-101	Terminal strip, antenna 88A020 or	88A679
	Tuning unit assembly; complete with tubes	1D1055
	CABINET PARTS	
	Antenna Silver Vortex	57C147
	Cabinet	78F718
	Cabinet back	8F1590
	Escutcheon, front controls	7D312
	Escutcheon, picture tube	7D250
	Eyelet, knob spacer	5A388
	Glass, safety	22D317
	Knob, OFF-VOLUME, BRIGHTNESS or HORIZONTAL HOLD controls	15B234
	Knob, CONTRAST, FOCUS or VERTICAL HOLD controls	15B269
	Knob, CHANNEL SELECTOR control	15D293
	Knob, FINE TUNING control	15A299
	Knob, BW/COLOR switch	15D454
PL-101	Line cord and plugs	87A1668
	Mask, picture tube	7D251
PL-102	Plug, safety interlock (part of PL-101)	- - - - -
PL-103	Plug, speaker	10A372
LS-101	Speaker, 10 inch PM	85C106
	Spring, tube escutcheon ground	75B195



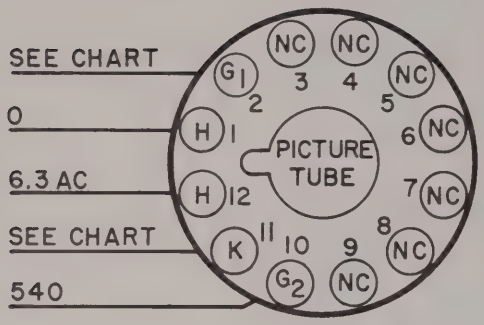
92C1669

Fig. 19. Voltage Chart for Main TV Chassis



9281670

Fig. 20. Voltage Chart for IF Strip



PIN	CONTRAST MIN.		BRIGHTNESS MIN.	
	BRIGHTNESS		CONTRAST	
	MAX.	MIN.	MAX.	MIN.
11	155	140	140	140
2	130	65	65	65

Fig. 21. Socket Voltage of Picture Tube

PICTURE TUBE ANODE HIGH VOLTAGE MEASUREMENT

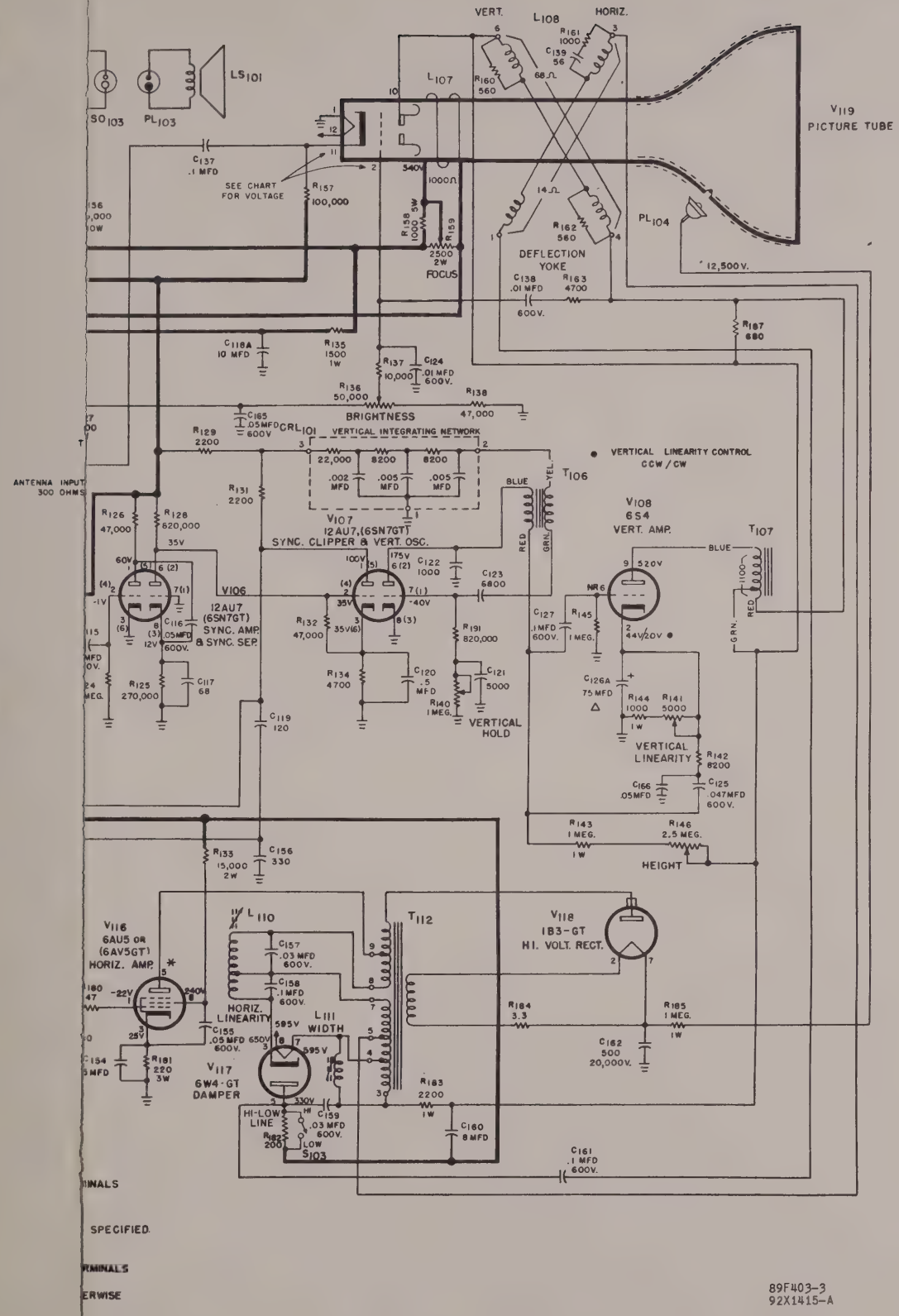
The second anode potential will be approximately 13,000 volts or higher in a receiver that is functioning properly. If it is possible to obtain good picture brilliance, the second anode potential is correct and need not be measured.

The setting of the horizontal drive control will affect the high voltage on the second anode. Instructions for setting this control are given in the section under the heading of "SERVICE ADJUSTMENTS".

If it is necessary to measure the voltage present on the second anode, a meter specifically designed for high voltage measurements should be used. The contrast and brightness controls should be rotated to the minimum position and PL-104 should be connected to the picture tube. Under these conditions the test meter will load the high voltage power supply approximately the same amount as the picture tube would during normal operation.

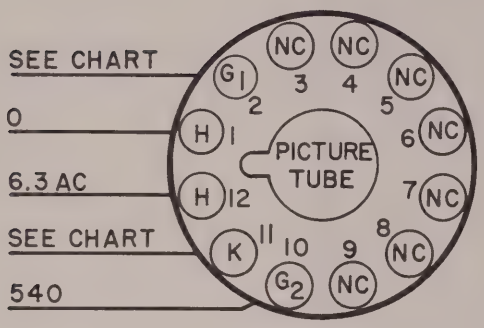
SAFETY FIRST

DO NOT USE HAND HELD FLEXIBLE TEST LEADS WHEN MAKING SECOND ANODE HIGH VOLTAGE MEASUREMENTS. ANY ACCIDENTAL CONTACT WITH THE HIGH VOLTAGE PRESENT IN THIS CIRCUIT MAY CAUSE A SEVERE BURN OR IN SOME CASES BE FATAL.



MODEL 21980

SCHEMATIC DIAGRAM



PIN	CONTRAST MIN.		BRIGHTNESS MIN.	
	BRIGHTNESS		CONTRAST	
	MAX.	MIN.	MAX.	MIN.
11	155	140	140	140
2	130	65	65	65

Fig. 21. Socket Voltage of Picture Tube

PICTURE TUBE ANODE HIGH VOLTAGE MEASUREMENT

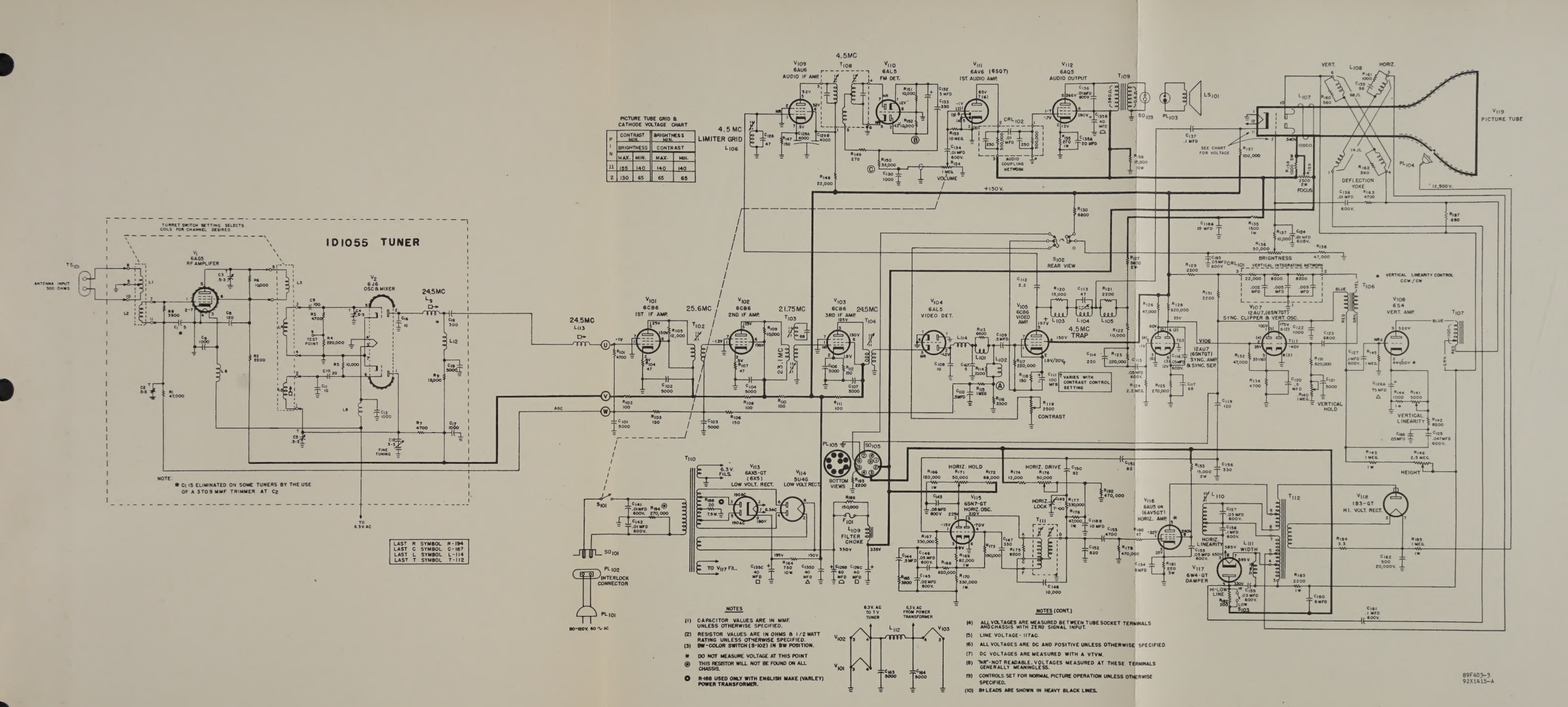
The second anode potential will be approximately 13,000 volts or higher in a receiver that is functioning properly. If it is possible to obtain good picture brilliance, the second anode potential is correct and need not be measured.

The setting of the horizontal drive control will affect the high voltage on the second anode. Instructions for setting this control are given in the section under the heading of "SERVICE ADJUSTMENTS".

If it is necessary to measure the voltage present on the second anode, a meter specifically designed for high voltage measurements should be used. The contrast and brightness controls should be rotated to the minimum position and PL-104 should be connected to the picture tube. Under these conditions the test meter will load the high voltage power supply approximately the same amount as the picture tube would during normal operation.

SAFETY FIRST

DO NOT USE HAND HELD FLEXIBLE TEST LEADS WHEN MAKING SECOND ANODE HIGH VOLTAGE MEASUREMENTS. ANY ACCIDENTAL CONTACT WITH THE HIGH VOLTAGE PRESENT IN THIS CIRCUIT MAY CAUSE A SEVERE BURN OR IN SOME CASES BE FATAL.



NOTES

(1) CAPACITOR VALUES ARE IN MMF. UNLESS OTHERWISE SPECIFIED.
(2) RESISTOR VALUES ARE IN OHMS & 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.
(3) BW-COLOR SWITCH (S-102) IN B/W POSITION.
* DO NOT MEASURE VOLTAGE AT THIS POINT
◉ THIS RESISTOR WILL NOT BE FOUND ON ALL CHASSIS.
● R-188 USED ONLY WITH ENGLISH MAKE (VARLEY) POWER TRANSFORMER.

NOTES (CONT.)

(4) ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS AND CHASSIS WITH ZERO SIGNAL INPUT.
(5) LINE VOLTAGE - 117AC.
(6) ALL VOLTAGES ARE DC AND POSITIVE UNLESS OTHERWISE SPECIFIED.
(7) DC VOLTAGES ARE MEASURED WITH A VTVM.
(8) "NR"-NOT READABLE. VOLTAGES MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS.
(9) CONTROLS SET FOR NORMAL PICTURE OPERATION UNLESS OTHERWISE SPECIFIED.
(10) B+ LEADS ARE SHOWN IN HEAVY BLACK LINES.

89F403-3
92X1415-A

VALUES AND TOLERANCES SHOWN ARE NOMINAL AND VARIATIONS MAY BE FOUND. IT IS RECOMMENDED THAT THE VALUE OF ANY REPLACEMENT CORRESPOND TO THE NOMINAL VALUE OF THE PART BEING REPLACED.

MODEL 21980

SCHEMATIC DIAGRAM